

CLAIMS

5 1. A bone boring device, comprising:
a needle base;
a pivot;
at least one curved needle having a tip at one end thereof and rotatably mounted on the
needle base, said needle and pivot arranged and adapted so that when said tip is placed against
bone tissue and said needle is rotated around said pivot, said needle is urged into said bone.

10 2. A device according to claim 1, wherein said pivot comprises a rotary hinge coupled to
said needle base.

15 3. A device according to claim 1 or claim 2, comprising a resting point adjacent said pivot
and on an outside of said device, which resting point is adapted to be placed against said bone.

20 4. A device according to any of claims 1-3, wherein said curved needle has a radius of
curvature matching a distance of said needle from said pivot.

25 5. A device according to any of claims 1-4, comprising:
at least one drill bit for drilling into said bone and defining a channel formed
therethrough and an aperture from the outside of said bit to said channel, wherein said at least
one needle is adapted to fit through said aperture.

30 6. A device according to claim 5, wherein said drill comprises a bone drill, adapted to
drill through a cortex portion of said bone.

35 7. A device according to claim 5, wherein said at least one needle is not suitable for
boring through a cortex portion of said bone.

40 8. A device according to any of claims 5-7, wherein said at least one drill bit comprises
two drill bits.

9. A device according to any of claims 5-7, wherein said at least one drill bit comprises a single drill bit.

10. A device according to claim 8, wherein said drill bits are positioned substantially parallel to each other.

11. A device according to claim 8 or claim 10, wherein said drill bits rotate in a same direction.

12. A device according to claim 8 or claim 10, wherein said drill bits rotate in opposite directions.

13. A device according to any of claims 8 or 10-12, wherein said at least one needle comprises at least two needles.

14. A device according to any of claims 8 or 10-12, wherein said at least one needle comprises a single needle.

15. A device according to claim 14, wherein said at least one needle, said channel, said aperture and said drill bits are arranged and adapted such that said at least one needle can pass through said channel in said at least one of said two drill bits, exit through said aperture and meet a second one of said two drill bits.

16. A device according to claim 15, wherein said second drill bit defines a receiving aperture in its side and wherein said needle meets said second drill bit at said receiving aperture.

17. A device according to claim 16, wherein said at least one needle comprises a detachable tip and wherein said receiving aperture is adapted to engage said detachable tip.

18. A device according to claim 17, wherein said receiving aperture comprises a narrowing of said aperture radially inside of a volume defined by said second drill bit.

19. A device according to claim 18, wherein said detachable tip is adapted to rotate inside said drill bit after said engagement, to lie within said volume.

20. A device according to any of claims 17-19, wherein said second drill bit defines an axial groove adjacent a drilling tip thereof, of a size sufficient for receiving a thread attached to said detachable tip.

21. A device according to any of claims 8 or 10-20, wherein said aperture is formed in a side of said drill bit.

22. A device according to any of claims 1-21, comprising a motor for rotating said drill bits.

23. A device according to claim 21, comprising a motor for rotating said drill bits.

24. A device according to claim 23, wherein said motor is a stepper motor adjusted to rotate said drill bits only whole numbers of rotations.

25. A device according to claim 23, comprising a mechanical stop for stopping said drill bits so that they are angularly aligned.

26. A device according to claim 23, comprising a sensor for detecting an angular position of at least one of said drill bits and comprising a controller for controlling said motor responsive to input from said sensor.

27. A device according to any of claims 1-4, wherein said at least one needle comprises a first needle and a second needle.

28. A device according to claim 13 or claim 27, wherein said needles rotate about a same pivot for urging into said bone.

29. A device according to claim 13 or claim 27, wherein said needles do not share a common hinge.

30. A device according to any of claims 13 or claims 27-29, wherein said needles are adapted to meet at their ends, when said needles are rotated around said pivot.

31. A device according to claim 30, wherein said needles meet tip-to-tip.

32. A device according to claim 30, wherein said needles meet side-to-side, at their ends.

33. A device according to any of claims 13 or 27-32 wherein said needles are formed with a conduit and wherein, when said needles meet, a continuous conduit is formed along the needles.

34. A device according to any of claims 30-32, wherein said first needle is adapted to engage a tip of said second needle.

35. A device according to claim 34, wherein said second needle is hollow, defining a conduit therethrough.

36. A device according to claim 34, wherein said second needle has a groove defined along most of its length, describing a conduit.

37. A device according to any of claims 33-36 and comprising a channel substantially contiguous with said conduit and adapted for advancing a thread through said channel and along said conduit.

38. A device according to claim 37, comprising a thread pusher for advancing thread through said conduit and said channel.

39. A device according to claim 38, wherein said thread pusher is long enough to extend through said channel and said conduit to outside said device.

40. A device according to any of claims 34-36, wherein said tip comprises a detachable tip to which the thread is attached.

41. A device according to claim 40, wherein said detachable tip comprises an extension to which a thread is attached, which extension is substantially longer than said second needle.

5 42. A device according to claim 34, wherein said second needle is detachable from said needle base.

43. A device according to claim 42, wherein said needles meeting causes said second needle to detach.

10 44. A device according to claim 43, wherein said second needle is adapted for attaching a thread thereto.

15 45. A device according to any of claims 34-44, wherein said first needle defines an aperture at its tip, which aperture is adapted to engage said tip of said second needle.

20 46. A device according to claim 45, wherein said aperture is an opening to a blind hole.

47. A device according to claim 45, wherein said aperture is an opening to a through hole which exists through a side in said needle.

48. A device according to claim 45, wherein said aperture connects to a hollow volume along an axis of said needle.

25 49. A device according to claim 48, comprising a sharp-tip mandrel that fills said hollow volume, for at least part of a rotation of said needle around said pivot.

50. A device according to claim 49, wherein said mandrel is retracted when said needles meet.

30 51. A device according to claim 45, wherein said aperture connects to a hollow volume having an axis oblique to an axis of said needle.

52. A device according to claim 45, wherein said aperture is an opening to a volume extending into said needle and having a substantially constant inner diameter.

53. A device according to claim 45, wherein said aperture is an opening to a volume extending into said needle and having an inner diameter that increases away from the aperture.

54. A device according to claim 45, wherein said aperture is an opening to a slotted volume.

55. A device according to any of claims 1-54, wherein said device comprises a handle.

56. A device according to claim 55, wherein said needles and said hinge are comprised in a disposable cartridge, separable from said handle.

57. A bone boring device, comprising:
at least one needle adapted for boring into bone;
a force providing element, remote from said needle, for advancing said needle; and
a force amplifier, coupled to said needle and adjacent to said needle which amplifies force provided from said force providing element and supplies it to said needle.

58. A device according to claim 57, wherein said at least one needle comprises two needles.

59. A device according to claim 57, wherein said needle is mounted on a hinge and wherein said needle is rotated around said hinge by force provided by said force amplifier.

60. A device according to claim 57, wherein said force amplifier comprises a lever.

61. A bone-boring device, comprising:
at least one curved needle adapted for extending to bore a hole in a bone;
a base holding said needle and including a portion on an outside of said device, which portion is adapted for being placed against a bone;
a handle coupled to the base; and

a needle retractor, which retracts said needle when a force on said handle in a particular direction is lower than a predetermined amount, prior to said base retreating from said bone in response to a lowering of the force.

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62. A bone-boring device, comprising:
at least one curved needle adapted for extending to bore a hole in a bone;
a base holding said needle and adapted for being placed against a bone
a handle coupled to the base; and
a needle advancer, which advances said needle only when a force on said handle in a
10 particular direction is higher than a predetermined amount, said predetermined force assuring
that said base is urged against said bone.

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63. A detachable tip for a needle, comprising:
a tip having a sharp end and adapted for boring through a bone; and
a flexible extension of said tip, opposite of said sharp end and substantially longer than
said sharp tip, attached to a thread.

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64. A tip according to claim 63, wherein said tip is adapted for being grasped by a non-
solid needle, at a side of the extension.

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65. A tip according to claim 63, wherein said sharp end is adapted for being grasped by a
hollow needle, at a side of the sharp tip opposite of the extension.

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66. A self-aligning device for boring into bone, comprising:
a boring head having at least two boring tips;
a body; and
a hinge coupling said head to said body at a location substantially equidistant from said
boring tips.

67. A device according to claim 66, wherein said boring tips comprise drill bits.

68. A device according to claim 66 or claim 67, wherein said boring tips comprise boring
needles.

69. A device according to any of claims 66-68, wherein said head includes a power source for activating said boring tips.

70. A device according to claim 66, wherein said boring tips face said handle.

71. A method for forming a channel in a bone, comprising:
drilling two holes in a cortex of the bone; and
advancing at least one needle through said drilled holes through a medulla of said bone.

72. A method according to claim 71, wherein said holes are perpendicular to a surface of said bone.

73. A method according to claim 71, wherein said at least one needle comprises two needles that meet inside the bone.

74. A bone boring device, comprising:
at least one bone-drilling drill bit defining a needle path therein; and
at least one needle adapted to travel along said needle path.

75. A device according to claim 74, wherein said needle path comprises a lumen.

76. A device according to claim 74 or claim 75, comprising a needle base and a pivot, wherein said at least one needle has a tip at one end thereof and is rotatably mounted on the needle base, said needle and pivot arranged and adapted so that when said tip is placed against bone tissue and said needle is rotated around said pivot, said needle is urged into said bone.

77. A device according to any of claims 74-76, wherein said at least one needle comprises at least two needles.

78. A device according to any of claims 74-77, wherein said at least one drill bit comprises at least two drill bits.